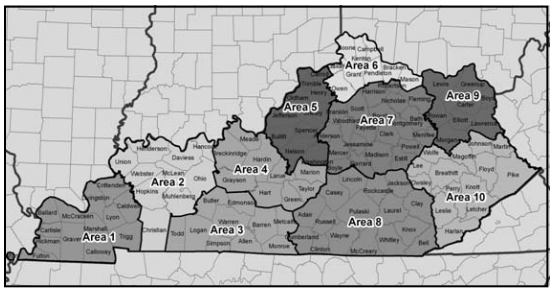

Medical Trade Area Analysis and Mapping Project

Final Report

for

Cabinet for Health and Family Services
Commonwealth of Kentucky

by

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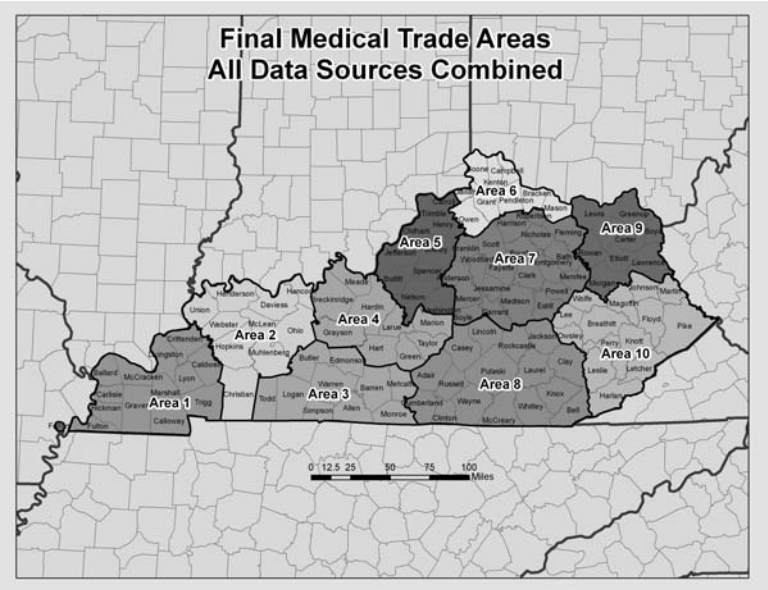
1. Executive Summary

A Medical Trade Area (MTA) is a largely self-organized geographic market area in which a delineated population receives most of its medical services. MTA identification takes into account where patients seek medical care as well as where their health professionals refer them for specialized medical care. In this regard, MTA analysis focuses on the geographic origins of patients (i.e. counties, towns, zip codes, etc.) seeking medical services and the geographic areas served by particular health care providers such as hospitals. Kentucky currently does not have identified MTAs. The medical trade area mapping project was undertaken to provide information that will assist the Kentucky e-Health Network Board in the development of Regional Health Information Exchange Organizations (RHIOs) which will become a focal point for the exchange of patient specific information relevant to providing appropriate and cost efficient healthcare services.

The goal of this project was to identify geographic clusters that characterize MTAs in Kentucky, based on the following criteria: 1) where Kentucky residents go to receive health care/medical services and 2) what geographical population areas are most appropriate for inclusion in a particular regional health information exchange operation. The project proposal specified that a geographic information system (GIS) be used to analyze Kentucky health services data and map the state's resulting MTAs.

Five de-identified, aggregated health services datasets were used in this analysis: 1) Kentucky Medicaid claims data, 2) Kentucky Hospital Association inpatient hospital discharge data and 3) Anthem Blue Cross Blue Shield, Bluegrass Family Health, and Humana private insurance claims data. An iterative process, using a series of mapping and spatial analysis techniques, was used to examine these data sources separately, then integrate them to establish Medical Trade Areas for the state of Kentucky.

Ten MTAs were identified, ranging in size from eight to twenty-one counties and containing populations ranging from roughly 187,000 to nearly one million. The GIS data-generated MTA map is shown below.



2. Introduction and Background

A Medical Trade Area (MTA) is a largely self-organized geographic market area in which a delineated population receives most of its medical services. MTA identification takes into account where patients seek medical care as well as where their health professionals refer them for specialized medical care. In this regard, MTA analysis focuses on the geographic origins of patients (i.e. counties, towns, zip codes, etc.) seeking medical services and the geographic areas served by particular health care providers such as hospitals. Kentucky currently does not have identified MTAs.

In geographic terms, MTAs are 'functional' or 'nodal' regions, organized around a hub, or focal point, and linked to surrounding areas by communication, transportation or some other sort of spatial interaction. For MTAs, this spatial interaction involves travel, but is quantified by patient origins and destinations. The terms 'MTA,' 'region' and 'MTA region' are used interchangeably throughout this report.

Regionalization schemes are nearly as ancient as the study of geography and many have been used for medical and health applications. Among the most well-known are those used by the Dartmouth atlases of health care (e.g. Wennberg 1996), which map characteristics of hospital referral regions. These regions are natural market areas that have been defined by patient origin studies at several levels of care. In general, geographic health service areas can be defined in several ways, each of which has ramifications in terms of data collection issues and analyses:

1. Patient origin. The service area is defined by compiling actual addresses for persons served. Although this approach provides very precise data, it also involves concerns about respondent burden, confidentiality, and data quality.

2. Geographic distance. The service area is defined by the maximum distance from which persons served come to the service. Distance measures are relatively simple in terms of data collection and management. However, because service areas rarely correspond to circular areas described by distance measures, the resulting data can be of relatively poor quality. In some cases, distance measures are converted to administrative units that fall within the specified distance (e.g. all counties that are entirely or partially within a 50-mile radius).

3. Geopolitical boundaries. The service area is defined by naming the states, counties, cities, ZIP codes or other administrative units in which services are provided. These units are familiar to most persons and may already be used by respondents in planning and describing their activities. However, geopolitical units may not correspond to service areas that are defined in terms of neighborhoods, and they are sometimes imprecise, such as when a city boundary spans county lines (Simpson et al. 1994).

The specific use of the term 'medical trade area' is not common in the geographic literature, but Smith (1979) described a method for their delineation that included socioeconomic data. Other methods include the computation of location quotients, an index of relative spatial distribution that provides an indication of how well saturated a resource is in a given area (Thrall et al. 2002).

In 2006, the Institute for Health Care Studies at Michigan State University identified medical trade areas for Medicaid beneficiaries, using counties as the unit of aggregation, with the criteria that each MTA should have a population of at least 500,000 and be centered around a

metropolitan area. Nine potential MTAs were identified and in- and out-migration patterns were analyzed.

The goal of this project was to identify geographic clusters that characterize MTAs in Kentucky, based on the following criteria: 1) where Kentucky residents go to receive health care/medical services and 2) what geographical population areas are most appropriate for inclusion in a particular regional health information exchange operation. The project proposal specified that a geographic information system (GIS) be used to analyze Kentucky health services data and map the state's resulting MTAs.

A geographic information system is an information management system that contains spatially referenced data, e.g. maps. Clarke (1999) has referred to GIS as 1) a toolbox, 2) an information system, and 3) an approach to science. As a toolbox, a GIS is a software package that contains a variety of tools and functions for processing, mapping and analyzing spatial data. As an information system, it contains a series of databases with observations about features and other entities with known locations. As an approach to science, it involves the study of the scientific disciplines, such as geography and cartography that have contributed to the development of GIS technology.

We used a combination of approaches 1 and 3 (patient origin and geopolitical boundaries) and a number of spatial analytical techniques to develop MTAs for Kentucky.

3. Data

This study utilized de-identified medical claims data from three sources: 1) Medicaid, 2) Kentucky Hospital Association inpatient hospital discharges, and 3) private insurance providers. All data were from calendar year 2006. Mapping focused on patient destination; however, patient origin data were used in the analysis of patient flows between counties. The data also provided valuable information about transactions across state borders. In the case of Medicaid, this included services provided to Kentucky residents in other states. For hospital discharges, the opposite was true: residents of neighboring states seeking hospital care in Kentucky were included in the database. Table 1 shows summary statistics for these data sources. The county-to-county records field provides an indication of travel across county and state borders (there are 7,140 possible county-to-county combinations in Kentucky alone).

Provider	County-to-County Records	Number of Claims
Medicaid	10, 295	6,503,202
Kentucky Hospital Association	5,694	621,729
Anthem	5,733	5,682,000
Bluegrass Family Health	2,408	107,525
Humana	47,494	15,051,523

Table 1: Number of claims, by provider, for 2006.

3.1 Medicaid Claims

Fee-for-service Medicaid claims data for 2006 were provided by the Kentucky Cabinet for Health and Family Services, Department for Medicaid Services. These data consisted of 9,610 county-to-county (origin-destination) records for claims within Kentucky and 4,366 county-to-ZIP code records for out-of-state destinations. In all, these represented over six million claims. GIS geocoding methods were used to assign county codes to out-of-state ZIP codes, resulting in 10,295 county-to-county records. For this analysis, data were obtained for all services combined. Neither pharmaceutical nor Passport data were analyzed.

3.2 Kentucky Hospital Association

Hospital discharge data were provided by the Kentucky Hospital Association. For 2006, these data consisted of 5,694 county-to-county (origin-destination) records representing 621,729 hospital visits. This database does not contain information about Kentucky residents who seek inpatient care outside of Kentucky.

3.3 Private Insurance Providers

Private insurance data were provided by three providers: 1) Anthem, 2) Bluegrass Family Health and 3) Humana. All data consisted of county-to-county (origin-destination) records and number of claims for each county-to-county combination. The Anthem database represented 1,030,138 patient claims, Bluegrass Family Health 107,525 and Humana more than 15 million.

4. Methods

We used an iterative process to delineate Medical Trade Areas. This process combined the patient origin and geopolitical boundaries approaches described in Section 2 (Introduction and Background). Our analysis did not require the direct use of patient addresses; however, all data providers aggregated patient address data by geographic units appropriate for this study. All mapping and analyses was conducted with Environmental Systems Research Institute's (ESRI's) ArcGIS software.

4.1 Geographic Unit of Analysis

Three geographic units were considered for identification and analysis of MTAs: 1) 5-digit ZIP codes, 2) 3-digit ZIP codes, and 3) counties. In general, smaller geographic units provide better spatial resolution, but pose problems with data confidentiality and rate instability. ZIP codes are especially problematic for health analyses for several reasons. First, ZIP codes were created for the delivery of mail, not analyses of health and socioeconomic data. Second, not all ZIP codes have spatial representation; many are set up for P.O. boxes in a single building whose location would not show up on a small-scale map. Third, ZIP codes often cross county boundaries, thus don't work well when county hierarchies are also considered. Finally, ZIP codes are not stable; they change over time depending on postal routes and mail delivery. Figures 1-3 show Kentucky 5-digit ZIP codes, 3-digit ZIP codes and counties, respectively.

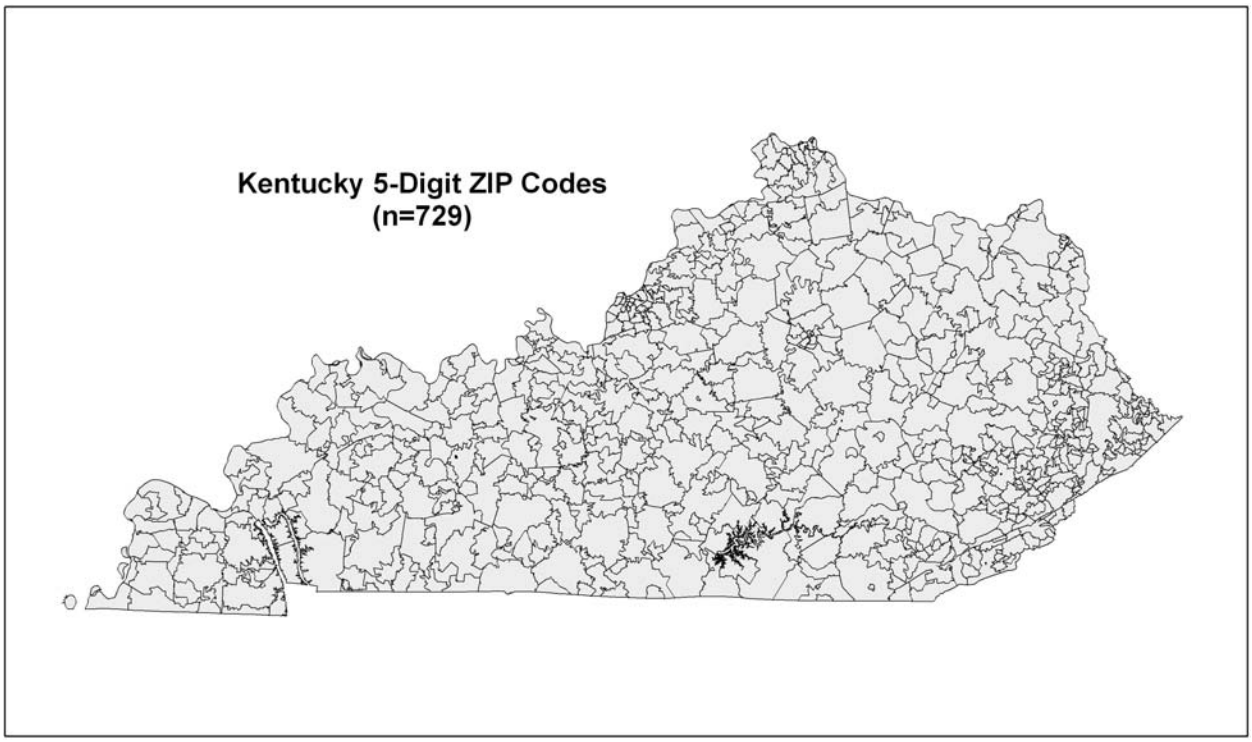


Figure 1: Kentucky 5-digit ZIP codes

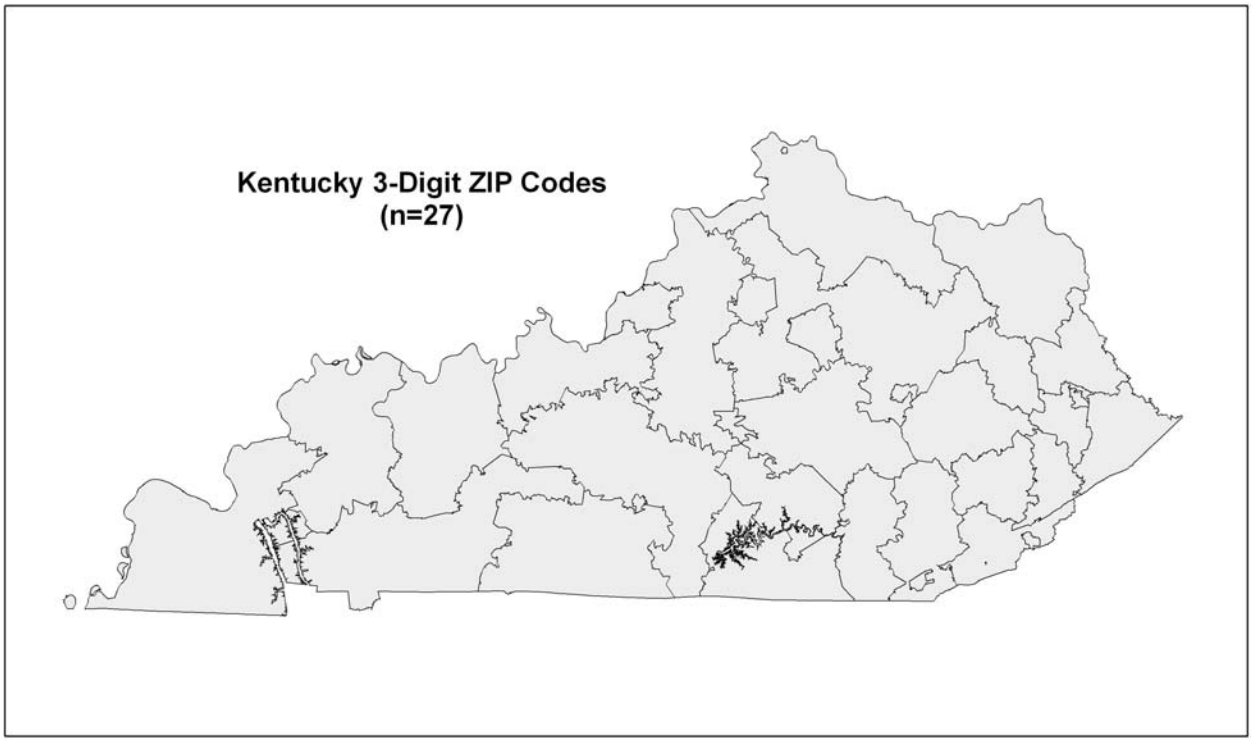


Figure 2: Kentucky 3-digit ZIP codes

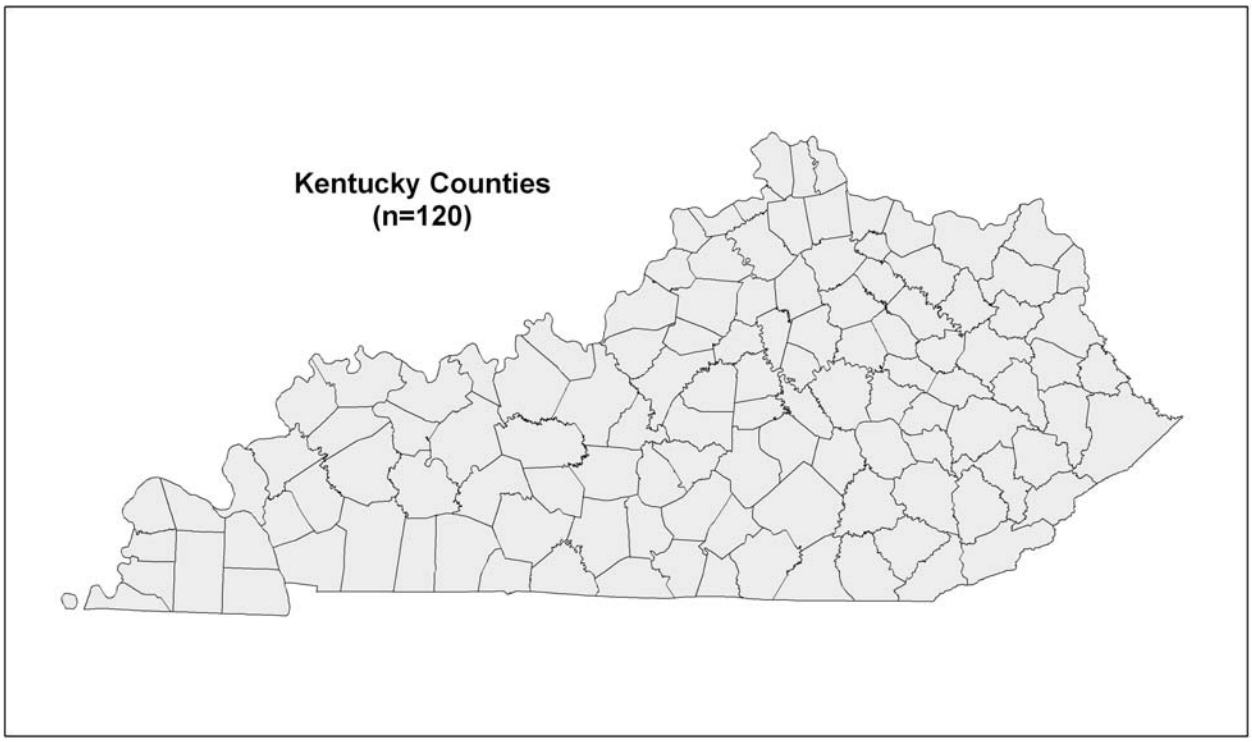


Figure 3: Kentucky counties

At the time of the study, Kentucky had 729 mappable 5-digit ZIP codes, twenty-seven 3-digit ZIP codes, and 120 counties. Based on issues with ZIP codes as a unit of analysis and the small

number of 3-digit ZIP codes, the county was chosen as the appropriate unit of analysis, particularly since its spatial resolution in Kentucky is far superior to that of 3-digit ZIP codes.

The development of KY MTAs incorporated the use of several well-documented mapping and spatial analysis techniques: 1) exploratory choropleth mapping, 2) Thiessen polygons, 3) gravity modeling, and 4) cartographic overlay analysis. These methods are described below, using the Medicaid data as an example.

4.2 Exploratory Choropleth Mapping

Choropleth mapping refers to the use of shades and colors to represent quantities in geographic areas. For each health services dataset, we produced choropleth maps showing the county-level distribution of patient destinations. These maps were used for two purposes: 1) the visual display of geographic areas where Kentuckians were receiving health services, and 2) the identification of central counties, or hubs, for MTA regions. The identification of hubs was somewhat subjective because it required the use of a cut-off (i.e. *x* number of transactions, or claims). Increasing the number of transactions for a cutoff resulted in fewer hubs (and, hence, fewer regions); lowering the number of transactions resulted in more hubs. For the five datasets used in the analysis, a range of seven to ten hubs was identified, depending on the geographic distribution of claims. County names are not printed on these maps due to size and shading constraints. However, a Kentucky county reference map is included in Appendix A.

Figure 4 shows the geographic distribution of Medicaid claims in Kentucky and adjacent states. There are 10 Kentucky counties with over 30,000 claims for 2006. These have been designated hubs for the purpose of establishing regions, or MTAs. A number of Kentucky residents sought services in adjacent states, particularly in the Covington/Cincinnati area. Higher numbers of claims are filed in Appalachian counties than in other regions of the state. This is particularly evident in southeastern Kentucky.

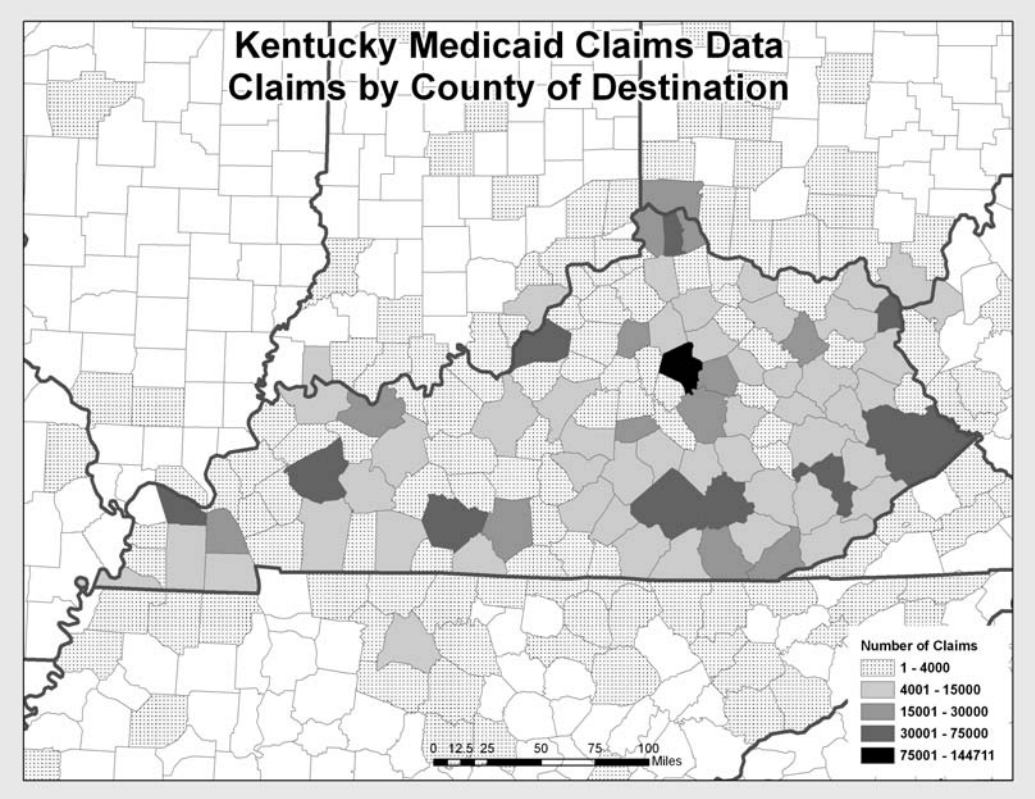


Figure 4: Medicaid claims by county of destination

4.3 Thiessen Polygons

After identifying potential hubs through choropleth mapping, distance was used to establish a region surrounding each hub, such that counties surrounding the hub or central county were generally closer to that hub than to another hub. This was achieved by using a well-known geographic technique, Thiessen polygon analysis. This is a mathematically-defined GIS function that works by computing a line between two hubs, then bisecting that line with a perpendicular one. These perpendicular lines are grouped together to form regions, as shown in Figure 5. Areas within each region are closer to said hub than any other. A cutoff of 30,000 claims was used to produce the regions in Figure 5, but this cutoff varied across the five service provider datasets. Because Thiessen boundaries are straight lines and not county boundaries, each county was assigned to one Thiessen region or another according to which region contained most of its area. The resulting region map, such as the one in Figure 6, shows the counties that make up each region, or MTA.

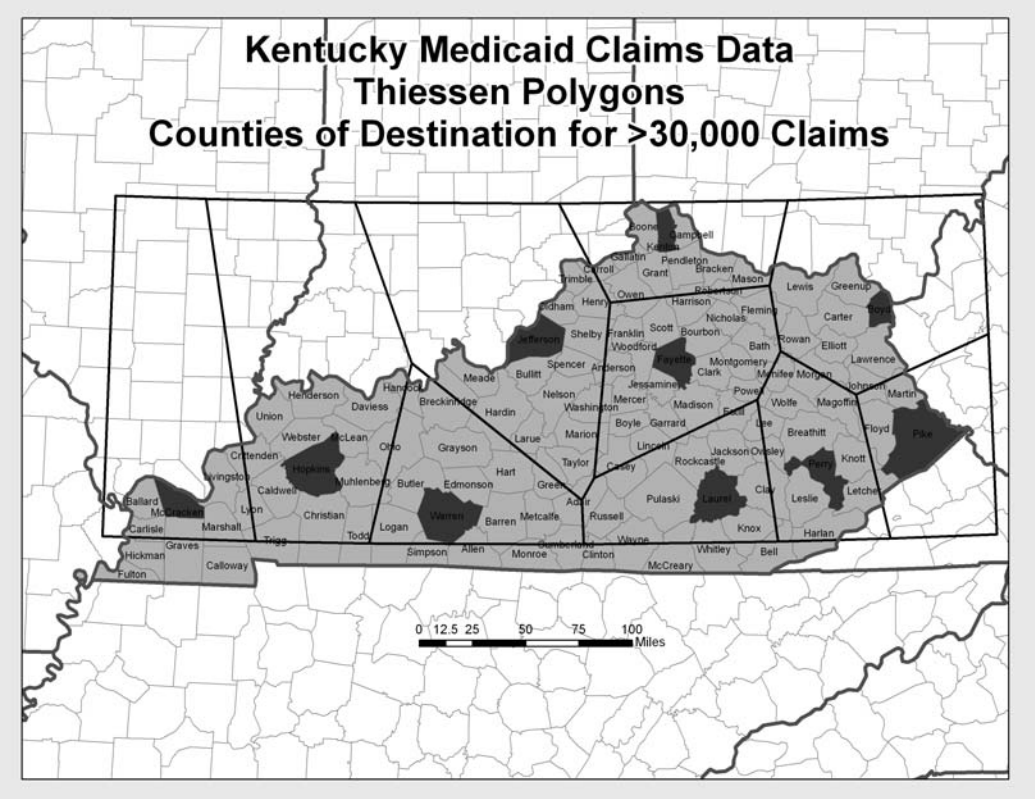


Figure 5: Thiessen polygons for Medicaid claims data

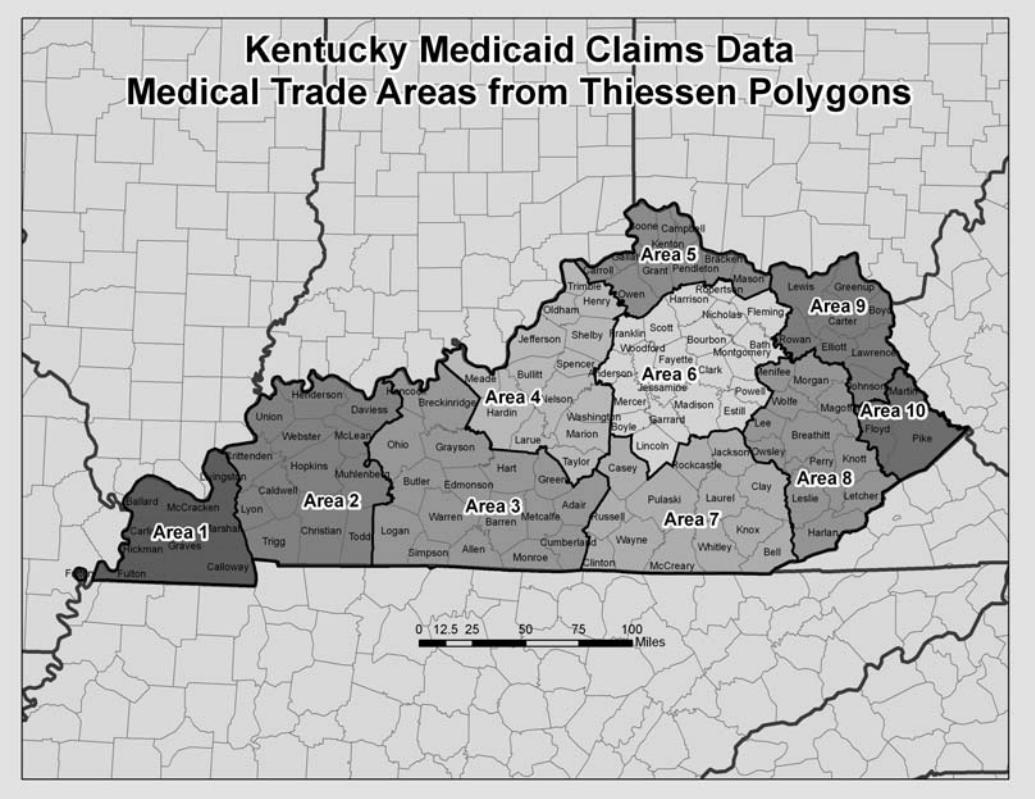


Figure 6: Medical Trade Areas from Thiessen polygons, Medicaid claims data

4.4 Gravity Model and Network Flows

While Figure 6 might look like a reasonable delineation of MTAs, it reflects only distance of each county from a hub and not spatial interaction among counties, i.e. patients traveling from one county to another for services. The gravity model is a measure that is used by geographers to measure spatial interaction. It is based on the concept that the closer two places are to each other and the more people there are in those two places, the more interaction (or travel) there will be between them. Typically, the strength or amount of interaction between two places is determined by multiplying their population (or, in this case, number of patient claims) and dividing this by the squared distance between them. Hence, the gravity model (modified for this study) is represented by the following formula:

$$\frac{\text{County 1 claims (from patients living in county 2)} \ \mathbf{X} \ \text{County 2 claims (from patients living in county 1)}}{\text{Distance between the two counties}^2}$$

In otherwords, the gravity model is a measure of how much patients are traveling between two counties. A higher amount of travel over a short distance yields a larger statistic. Appendix B shows numerical results from the model from a sample of northern Kentucky counties, using Medicaid claims.

The use of the gravity model, along with network flow visualization software (ET Geowizards, version 9.7 for ArcGIS 9.2, built: 12-18-2007, Copyright: Ianko Tchoukanski of Spatial Techniques), was used to tweak the boundaries of the distance-based MTA map in Figure 6, resulting in a new delineation of regions that better reflects patient travel and referral patterns. For instance, an examination of Appendix B indicates that Carroll County belongs in Area 4, with Jefferson County instead of Area 5 with Kenton County. This is because people in Carroll County are more likely to travel to Jefferson County for services even though it is farther away. Jefferson County, being a larger county with more services, has a greater pull (i.e. more gravity). The visualization of service provider flow lines was an important part of the gravity modeling process because it allowed us to focus on those counties with the greatest levels of interaction and ignore the "noise" from very small counties. (Note: with 120 counties, the number of combinations, two counties at a time, is 7140). Figure 7 shows county-to-county flows between Medicaid patients and service providers for all flows involving 1000 or more claims.

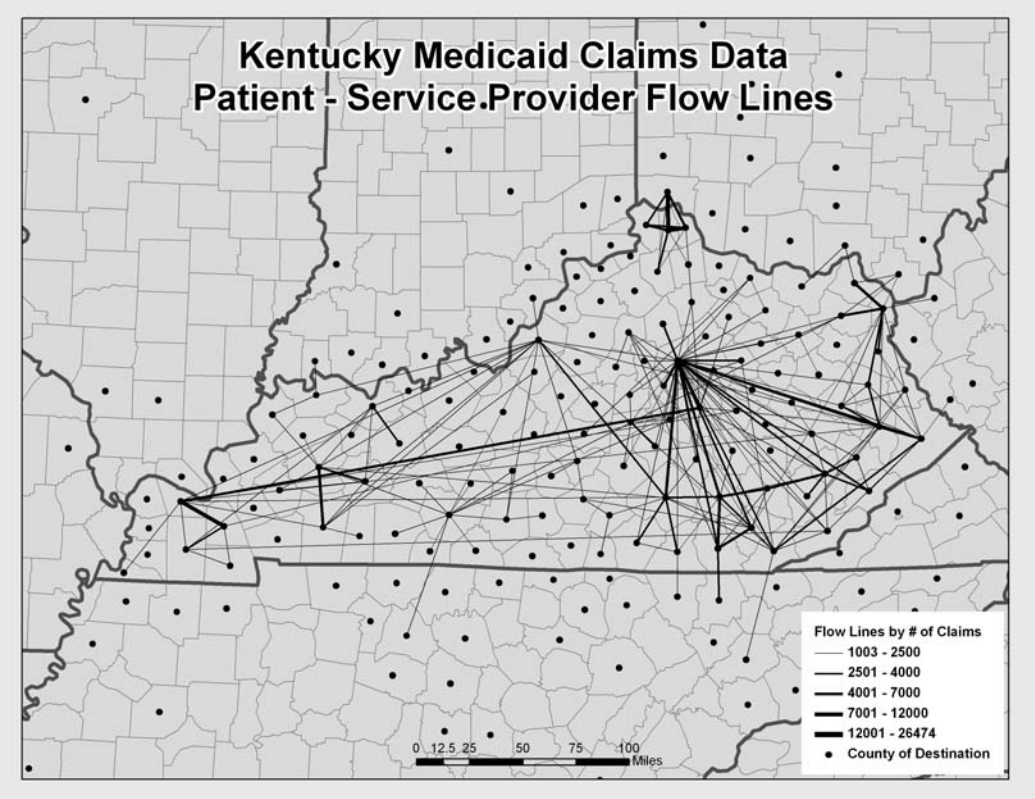


Figure 7: Patient-service provider flows for Medicaid claims data

Several patterns are apparent in Figure 7. First, the northern Kentucky counties of Boone, Kenton, Campbell, Grant and Pendleton comprise a discrete service area. Many residents in these counties obtain services in Cincinnati. There is also strong and fairly isolated interaction in the Ashland area, among Boyd, Greenup, Carter and Lawrence Counties, with some flow to Huntington, West Virginia. Lexington (Fayette County) exerts a powerful pull on southeastern Kentucky. Residents of McCreary, Whitley and Bell Counties seek services in the Tennessee counties of Scott, Campbell and Knox, respectively. Louisville (Jefferson County) attracts patients from south-central and western Kentucky, although the exclusion of Passport data in this analysis probably skews these results. Bowling Green, Owensboro and Paducah show up as regional hubs and the interaction between Bowling Green and Nashville is apparent. What is perplexing on this map is the interaction between Paducah and Richmond. It may indicate a drop box or mailing address, although the Department for Medicaid Services has confirmed that our database contains information about where services were rendered, not where claims were mailed. After the application of the gravity model to those counties with higher levels of spatial interaction, the MTA boundaries were adjusted.

4.5 Cartographic Overlay Analysis

The final step of the analysis involved overlaying the individual MTA maps for all five datasets and integrating them into a final MTA map. In cases where MTA designations were consistent, the assignment of a county to a specific MTA was clearcut (e.g. Fulton County fell into the westernmost MTA for all datasets). When designations were not consistent, a weighting scheme was used based on the number of claims for that particular dataset. For example, the Humana MTA map had a greater influence on the final map than the Bluegrass Family Health MTA map

because the Humana dataset contained over 15 million claims. Hence, Meade County was assigned to the same MTA as Hardin County, instead of the MTA that contained Jefferson County.

5. Results

5.1 Medicaid Claims

Ten MTAs were delineated for Medicaid claims data. The steps of the process have been described in Section 4 and results displayed in Figures 4-7. Figure 8 shows the revised Medicaid MTA map. An examination of Figures 6 and 8 shows some movement of counties to new MTA regions, based on information from the gravity modeling.

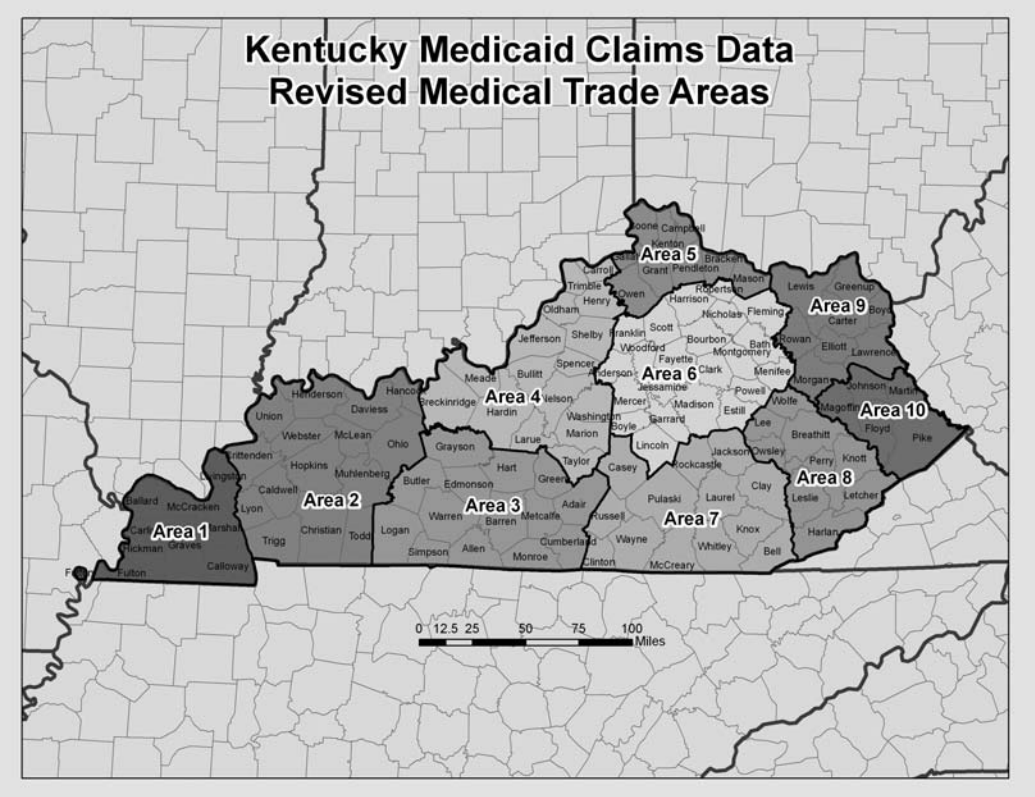


Figure 8: Revised Medical Trade Areas, Medicaid claims data

5.2 Kentucky Hospital Association

Figure 9 shows hospital discharges by county of destination. As already noted, these may also reflect hospital visits by non-Kentucky residents. This database does not contain information about out-of-state hospital visits made by Kentucky residents. The three counties with the highest numbers of discharges are Jefferson, Fayette and McCracken (cities of Louisville, Lexington and Paducah). Ten counties had at least 15,000 discharges. These counties were identified as hubs for MTA designations. Thiessen polygon analysis and the resulting MTAs are shown in Figures 10 and 11, respectively. Because the hospital discharge database does not capture out-of-state hospitalizations, such as those that occur in Cincinnati, the northern Kentucky counties do not show up as a separate region.

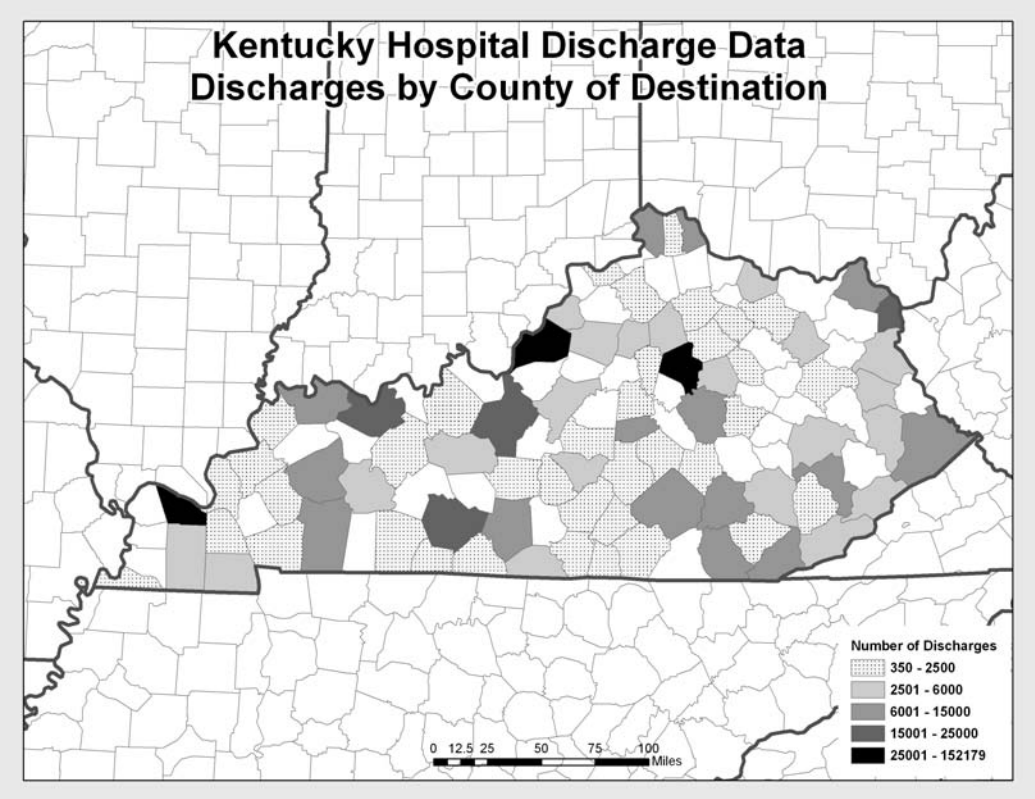


Figure 9: Hospital discharges by county of destination

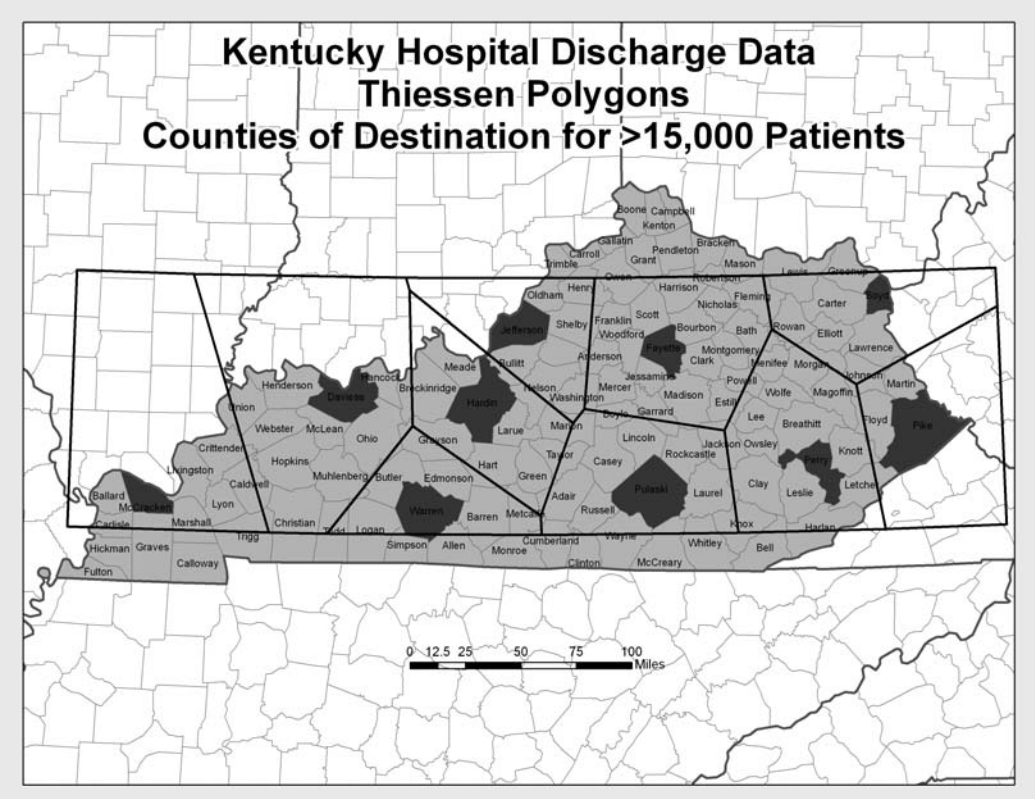


Figure 10: Thiessen polygons for hospital discharge data

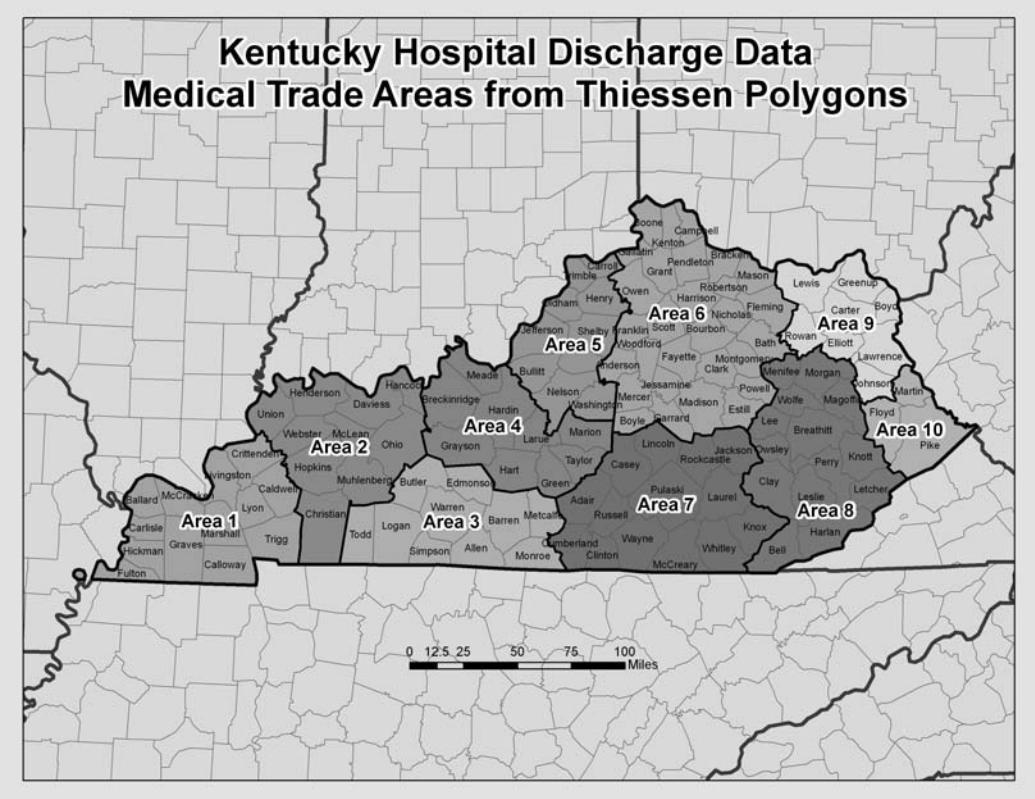


Figure 11. Medical Trade Areas from Thiessen polygons, hospital discharge data

Patient flows of 100 discharges or more between counties are shown in Figure 12. The Louisville, Lexington and Paducah hubs are apparent on this map. As with Medicaid claims, it is obvious that many patients in southeastern Kentucky are drawn to Lexington for hospital care. Perry County (Hazard) shows up as a more localized service area, as do the areas around Owensboro, Ashland, and Bowling Green. Interaction with local counties also occurs in Barren County (Glasgow). Modifications to the MTA regions, based on patient-provider flows, are shown in Figure 13.

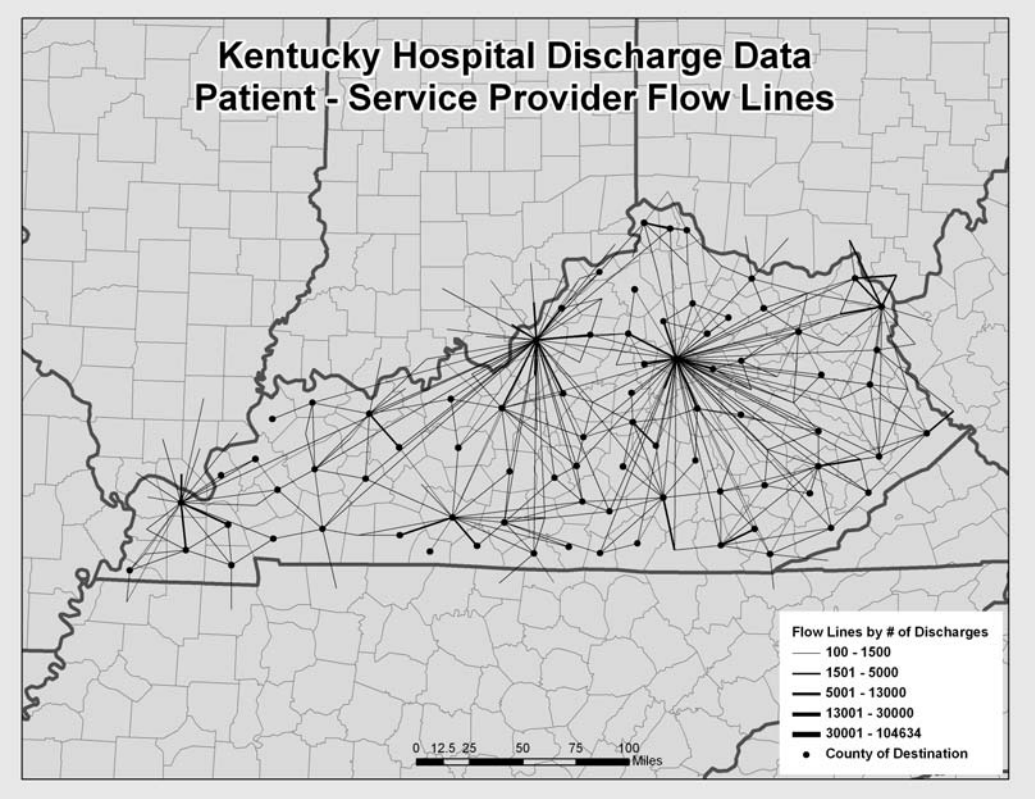


Figure 12. Patient-service provider flows for hospital discharge data

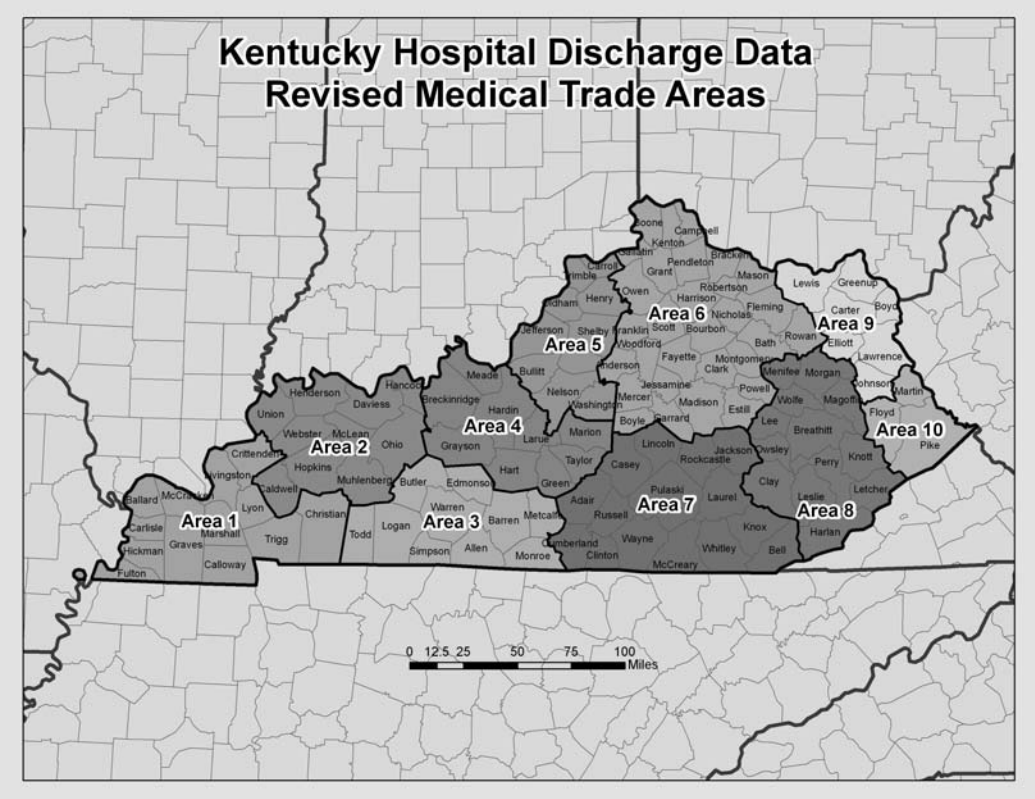


Figure 13: Revised Medical Trade Areas, hospital discharge data

5.3 Private Insurance Providers

Choropleth mapping, Thiessen polygon analysis and preliminary identification of MTA regions were carried out for each of the three private insurance providers separately. However, data from all three providers were combined for the network flow analysis.

5.3.1 Anthem

Figure 14 shows Anthem claims data. No out-of-state data were included in the Anthem dataset. The number of claims, by county, falls off rapidly after Jefferson and Fayette Counties, making the identification of regional hubs somewhat subjective. After careful examination of county-level claims, nine hubs were identified and subjected to Thiessen polygon analysis. These are shown in Figure 15. Resulting Medical Trade Areas are shown in Figure 16.

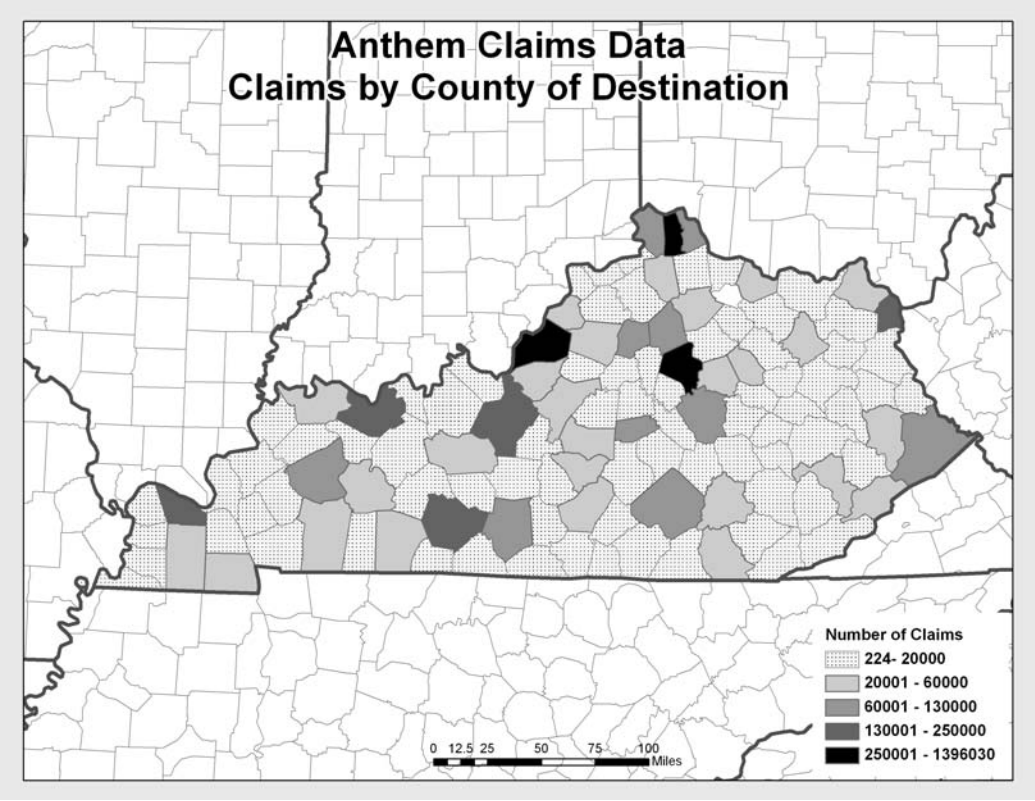


Figure 14: Anthem claims data by county of destination

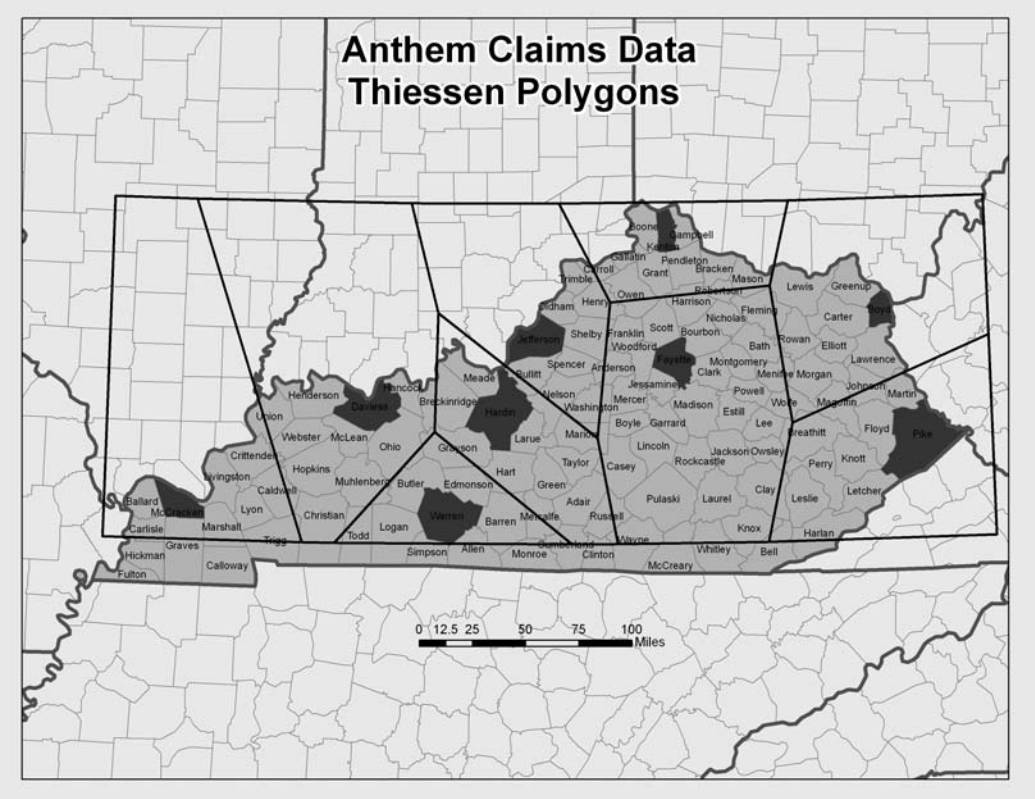


Figure 15: Thiessen polygons for Anthem claims data

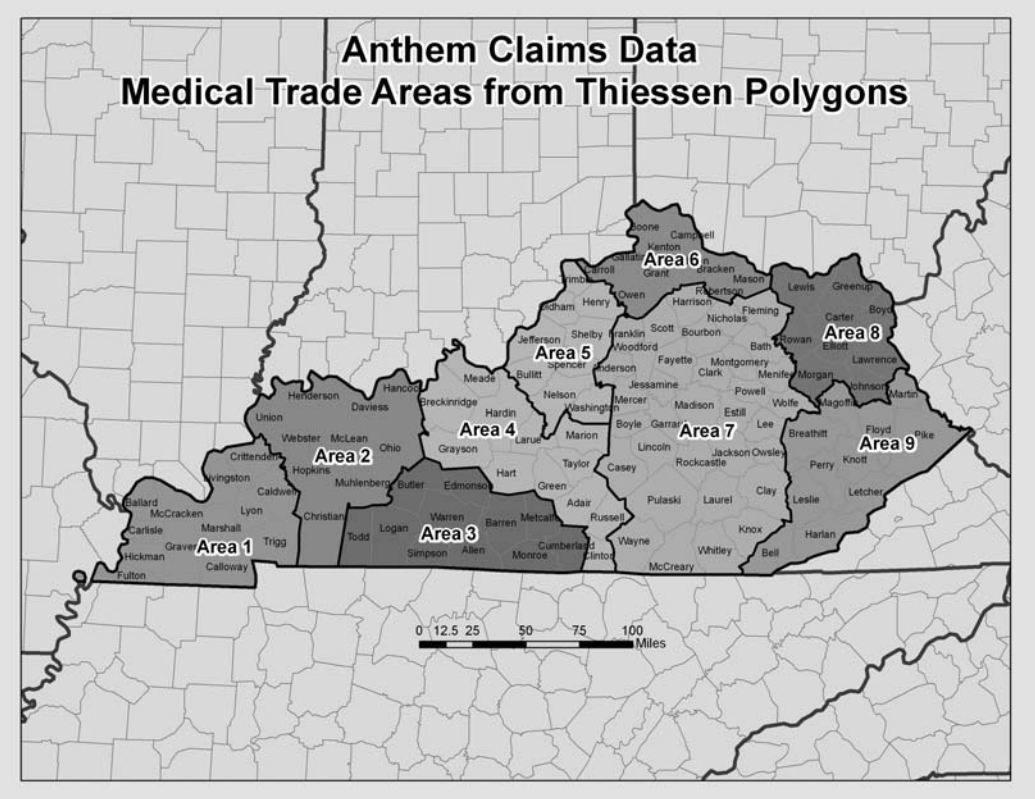


Figure 16: Medical Trade Areas from Thiessen polygons, Anthem claims data

5.3.2 Bluegrass Family Health

Figure 17 shows the county distribution of claims data from Bluegrass Family Health. No out-of-state data were included in this dataset. The number of claims is the lowest of the three private providers, with the highest number in Lexington, as expected. Seven regional hubs were identified and subjected to Thiessen polygon analysis. These are shown in Figure 18. Resulting Medical Trade Areas are shown in Figure 19.

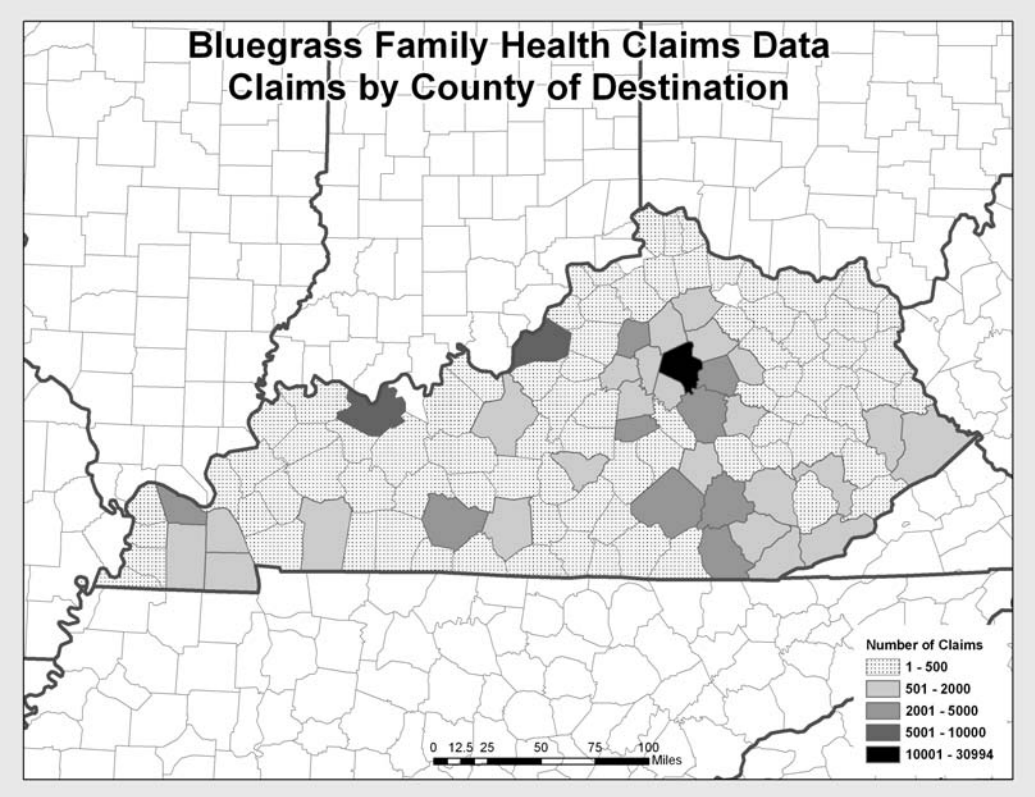


Figure 17. Bluegrass Family Health claims data by county of destination

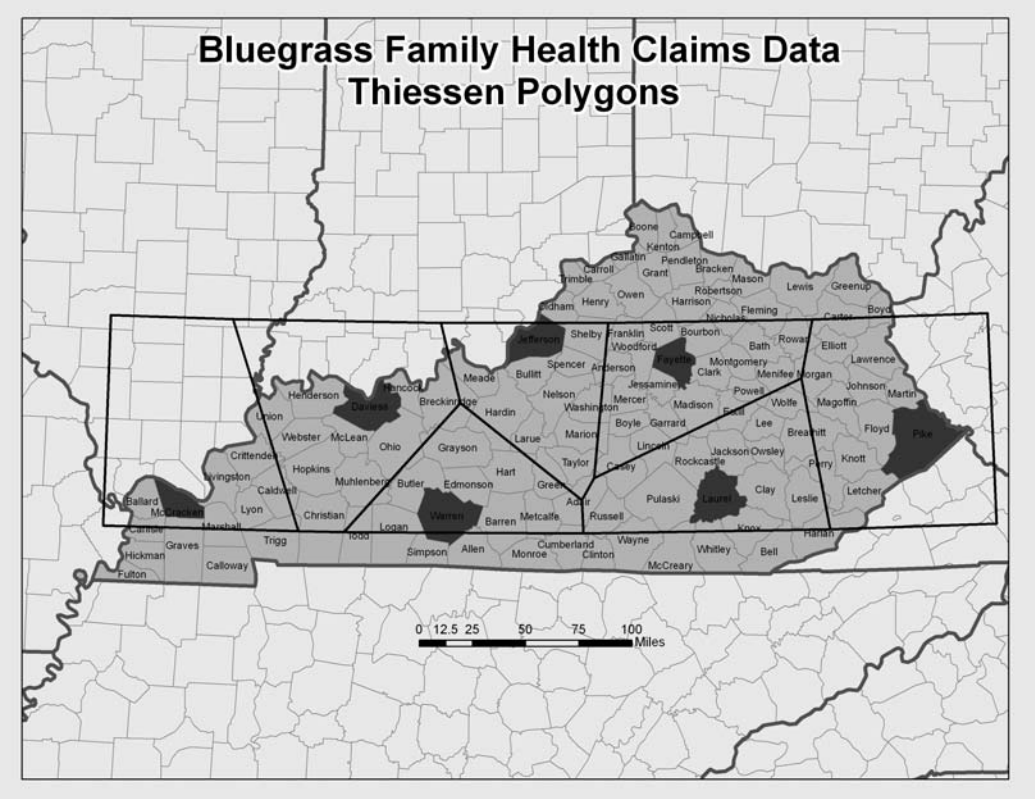


Figure 18: Thiessen polygons for Bluegrass Family Health claims data

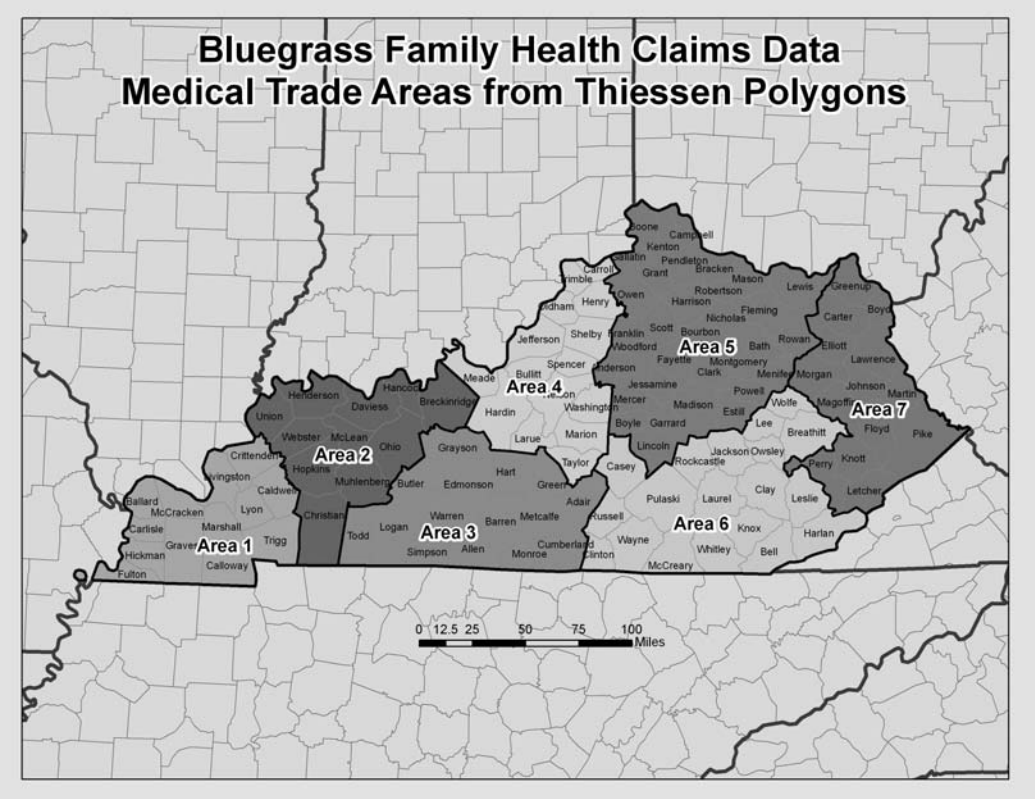
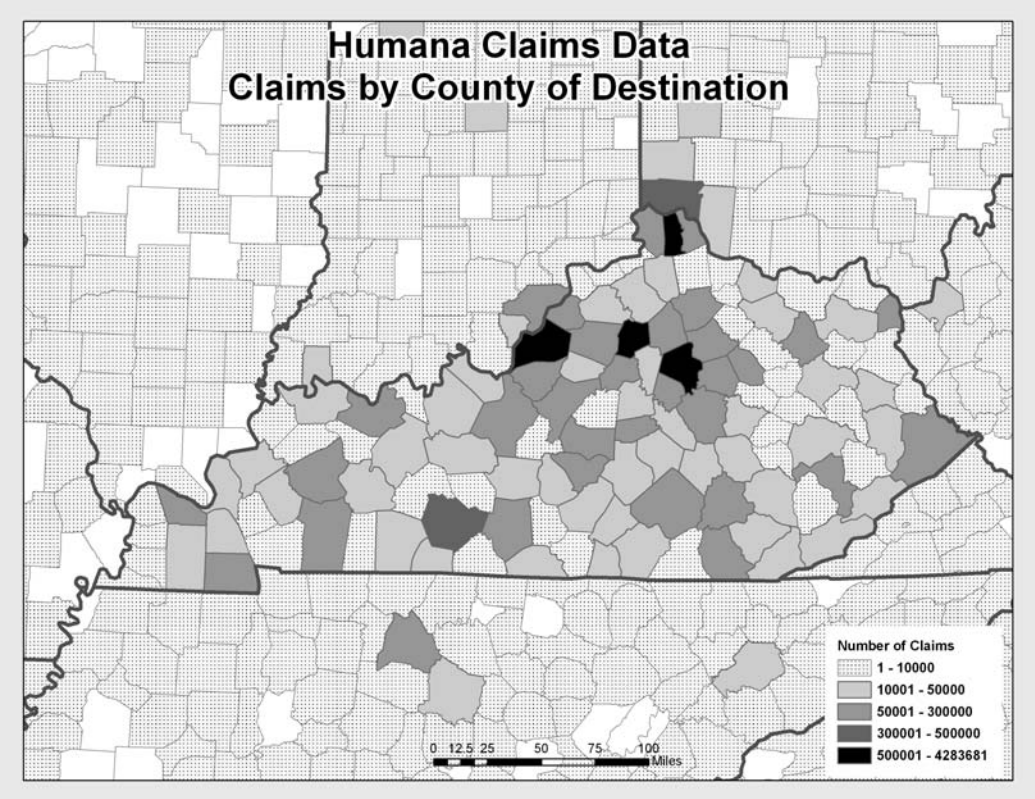


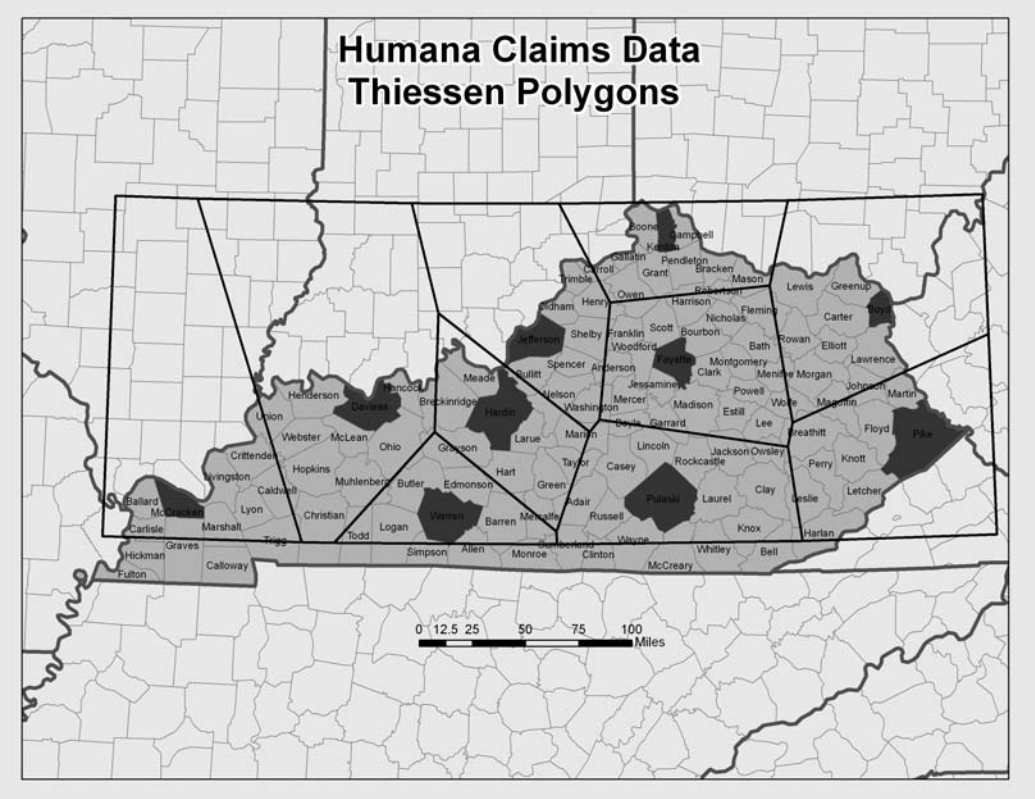
Figure 19: Medical Trade Areas from Thiessen polygons, Bluegrass Family Health

5.3.3 Humana

The Humana dataset contained over 15 million claims, including claims for services rendered outside of Kentucky. Humana claims by county of destination are shown in Figure 20. While claims extended across far parts of the U.S., only counties adjacent to Kentucky are shown on this map. As expected, Humana claims are most numerous for services provided in Louisville, Frankfort, Lexington and Covington. Franklin County (Frankfort) showed up as a major service destination because Kentucky State Employees are covered by Humana. We identified 10 hubs for Thiessen polygon analysis, as shown in Figure 21. The resulting MTAs are displayed in Figure 22.



20. Humana claims data by county of destination



21. Thiessen polygons for Humana claims data

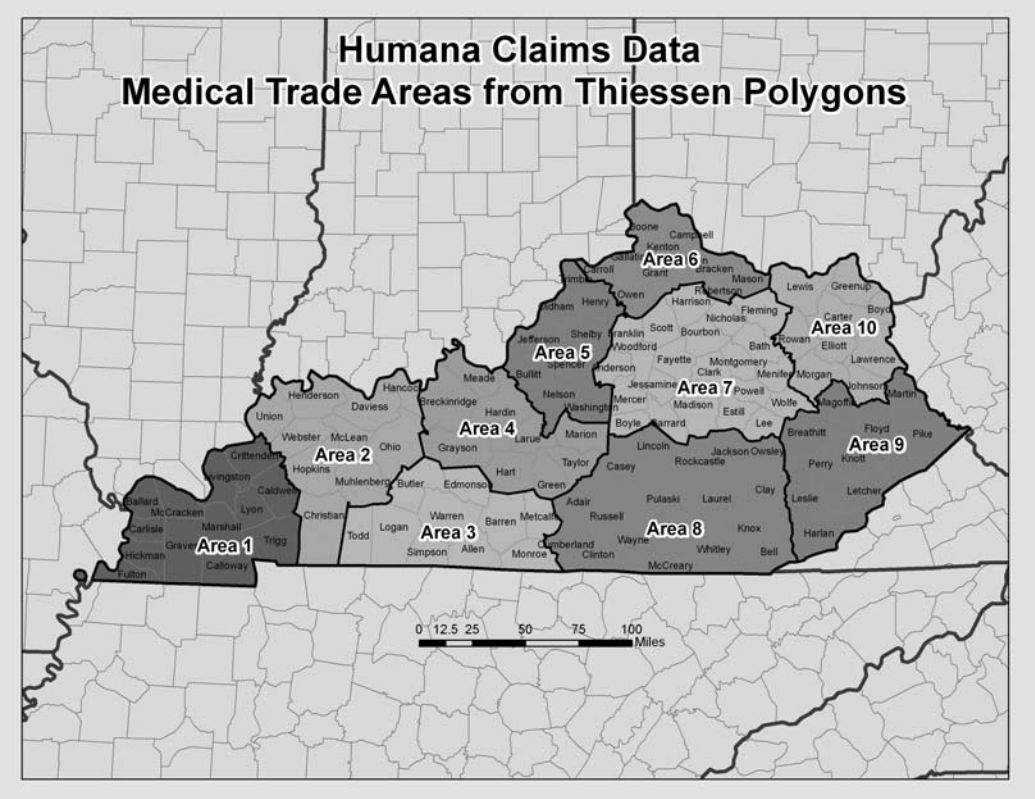


Figure 22: Medical Trade Areas from Thiessen polygons, Humana claims data

Figure 23 shows patient-provider flows for all private insurance providers combined. Of course, with over 15 million claims, this map is dominated by Humana data. The strongest visual pattern is that of three primary hubs: Louisville, Lexington and the Cincinnati/northern Kentucky region. The most common out-of-state interactions took place between Kentucky counties and Cincinnati, Nashville (TN), Murfreesboro (TN), Evansville (IN), Huntington (WV) and Chicago (beyond the extent of the map).

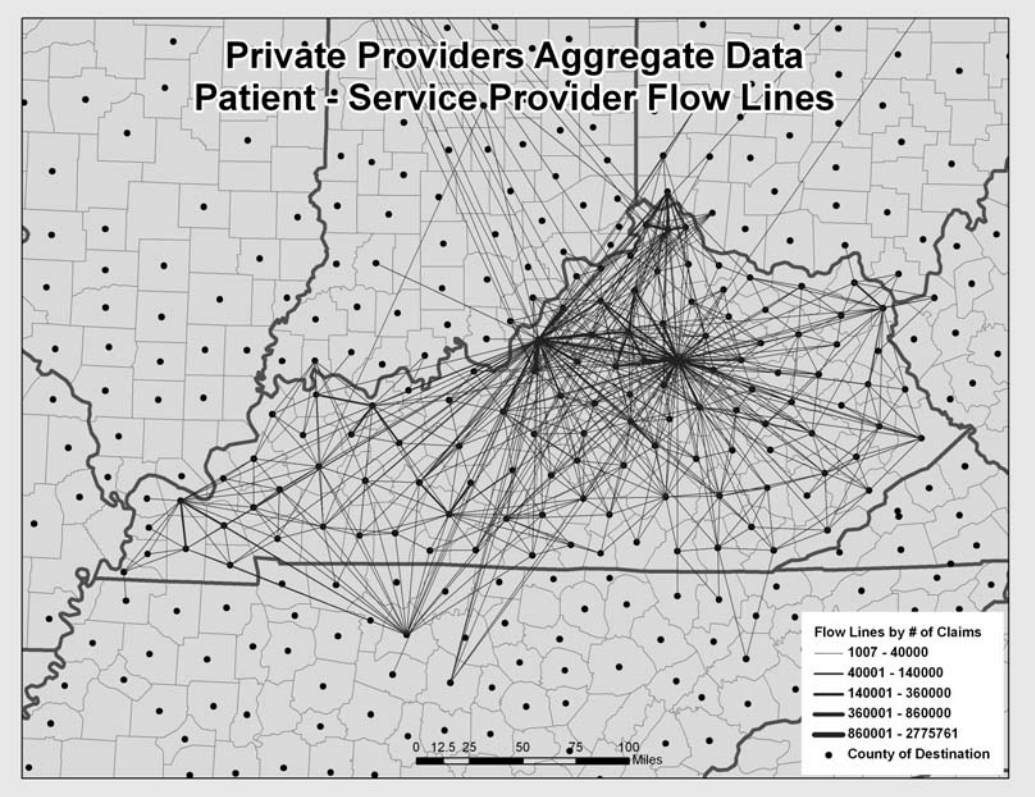


Figure 23: Patient-service provider flows for all private insurance providers combined

5.4 Final Medical Trade Areas

The Medical Trade Area maps from all five data sources were visually overlaid and boundaries for the final MTAs were drawn. For those counties that consistently fell into the same MTA (for several or all service providers), assignment of the final MTA was clear cut. For counties whose MTA membership varied across maps (i.e. varied by service provider), consideration was given to the number of claims by data source, such that the Humana designations were given more weight than those of Bluegrass Family Health, for instance. In some cases, transportation networks were examined to assist in making a decision. An effort was made to limit the number of MTAs to ten, since three of the five data sources yielded ten MTAs via the Thiessen polygon analysis.

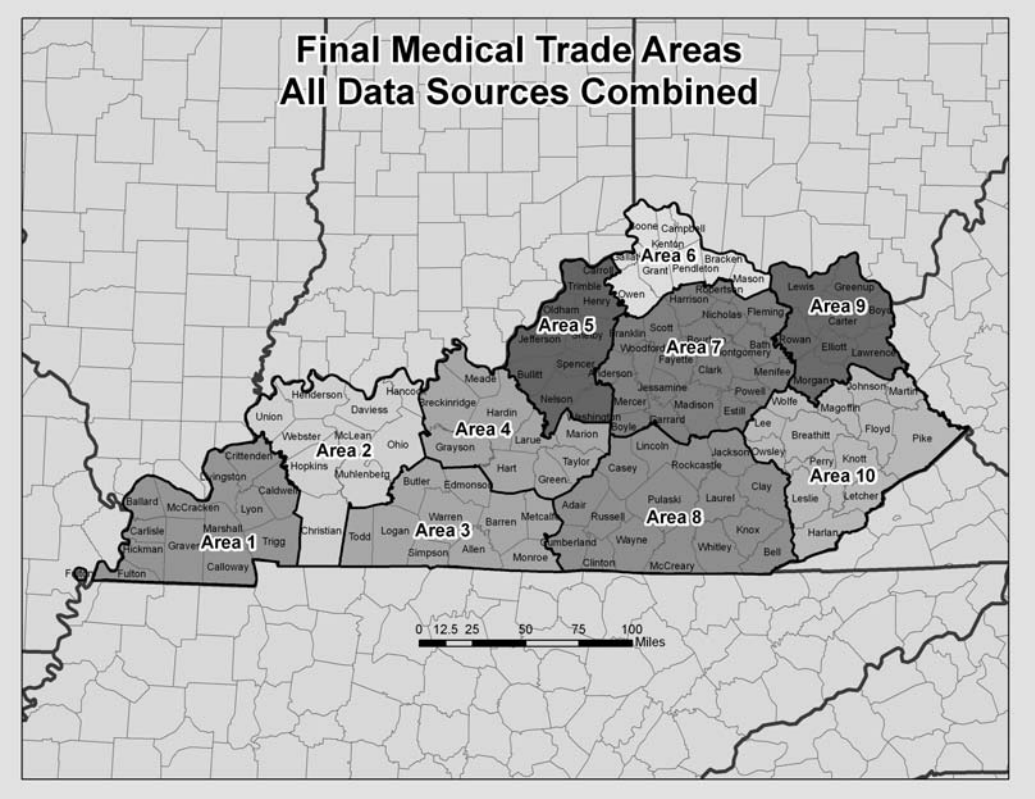


Figure 24: Final Medical Trade Areas, all data sources combined

Table 2 lists the counties that make up each Medical Trade Area and the total population of those counties, using July 1, 2006 estimates from the U.S. Census Bureau. With the exception of MTA 9, all trade areas had a population of at least 200,000.

MTA	Counties	Total Population*
1	Ballard, Caldwell, Calloway, Carlisle, Crittendon, Fulton, Graves, Hickman, Livingston, Lyon, Marshall, McCracken, Trigg	247,236
2	Christian, Daviess, Hancock, Henderson, Hopkins, McLean, Muhlenberg, Ohio, Union, Webster	365,255
3	Allen, Barren, Butler, Edmonson, Logan, Metcalfe, Monroe, Simpson, Todd, Warren	264,510
4	Breckinridge, Grayson, Green, Hardin, Hart, Larue, Marion, Meade, Taylor	254,864
5	Bullitt, Carroll, Henry, Jefferson, Nelson, Oldham, Shelby, Spencer, Trimble, Washington	974,175
6	Boone, Bracken, Campbell, Gallatin, Grant, Kenton, Mason, Owen, Pendleton	435,859
7	Anderson, Bath, Bourbon, Boyle, Clark, Estill, Fayette, Fleming, Franklin, Garrard, Harrison, Jessamine, Madison, Menifee, Mercer, Montgomery, Nicholas, Powell, Robertson, Scott, Woodford	770,892
8	Adair, Bell, Casey, Clay, Clinton, Cumberland, Jackson, Knox, Laurel, Lincoln, McCreary, Pulaski, Rockcastle, Russell, Wayne, Whitley	399,770
9	Boyd, Carter, Elliot, Greenup, Lawrence, Lewis, Morgan, Rowan	187,012
10	Breathitt, Floyd,Harlan, Johnson, Knott, Lee, Leslie, Letcher, Magoffin, Martin, Owsley, Perry, Pike, Wolfe	304,871

* U.S. Census Bureau, 2006 estimates.

Table 2. Membership counties and total population of Medical Trade Areas

V. Conclusions and Recommendations

Using a suite of mapping and spatial analysis methods, we have established GIS data-generated Medical Trade Areas for five health service data providers and integrated these MTAs into a single group of MTAs for the state of Kentucky. This regionalization scheme differs from other approaches, in terms of the data used to produce it and the mapping and analysis techniques used.

The *Dartmouth Atlas of Health Care* used Medicare data to establish hospital referral regions (HRR) and, within those regions, hospital service areas. The hospital referral regions for Kentucky often extend beyond the state's borders and differ from the MTAs identified in this study. They are: 1) Lexington, which includes almost every county in the eastern half of Kentucky; 2) Covington, which is comprised of the northern Kentucky counties; 3) Louisville, which contains the cities and counties of central Kentucky all the way to the Tennessee border; 4) Paducah, which includes nearly all of far western Kentucky; and 5) Owensboro in northwestern Kentucky. Many of the more remote areas of Kentucky were grouped with HRRs in neighboring states: Pineville and Middlesboro are included in the Knoxville (TN) HRR; Ashland and surrounding areas are in the Huntington (WV) HRR; portions of Greenup and

Lewis counties fall into the Columbus (OH) HRR; Fulton County was assigned to the Memphis (TN) HRR; counties west of Owensboro were grouped with the Evansville (IN) HRR and the area from Bowling Green to Hopkinsville falls into the Nashville (TN) HRR.

The state of Kentucky has mapped out eight Medicaid Provider Service Regions which differ from the ten Medicaid MTAs and ten final MTAs delineated in this analysis (Figure 25). The greatest differences occur in the western half of Kentucky, where the MTAs are slightly smaller than the state's Medicaid regions in geographic area.

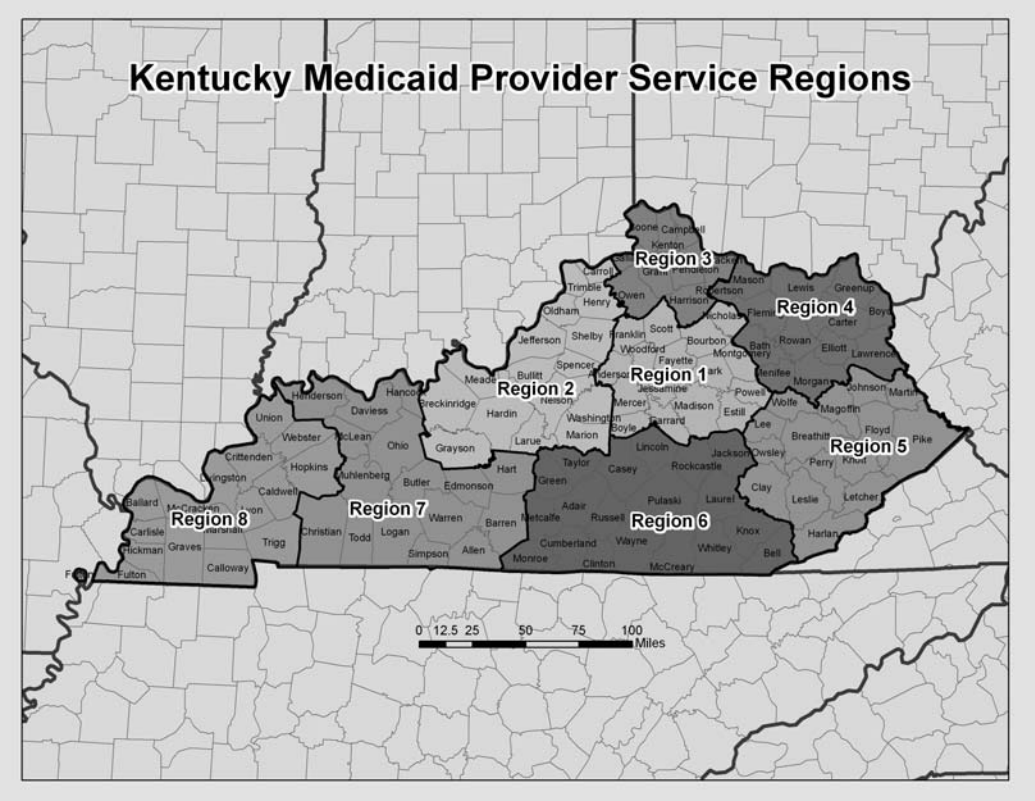


Figure 25: Kentucky Medicaid Provider Service Regions (Adapted from Kentucky Pharmacy and KYHealth Choices, https://kentucky.fhsc.com/kmaa/providers/Contacts_ServiceRep.asp)

Many methods exist for delineating health service areas and we have used an iterative approach to define MTAs. The mapping and spatial analysis methods are well-established but the combination of methods is not documented in the geographic health services literature, making this approach innovative. Throughout the process, judgment and subjectivity have been required to determine an appropriate number of MTAs (10), identify claims cut-off points for trade area hubs, and weight the five different MTA maps to establish the final GIS data-generated MTAs.

The geographic information systems analysis of medical claims data and health services service areas is a critically important input, but not the only input, for defining the medical trade areas that will form the basis for development of Regional Health Information Organizations (RHIOs). While in many instances, the interaction of patients and health care providers is readily obvious, there will be cases requiring further analysis and judgment calls from those familiar with and

more closely involved with patients and care providers in particular regions of the State. It is therefore recommended that the KeHN Board provide an opportunity and a means of soliciting the comments and suggestions related to the data provided by the MTA mapping project by the various health care related stakeholder groups that will be involved in the development of and the use of the functional inputs and outputs of RHIOs.

It is anticipated that the data generated by the analysis of geographic patient and provider interactions in the State will help health care stakeholder groups make appropriate decisions about the size and operational scope related to the development of RHIOs. But, inasmuch as a 'business case' will need to be made for RHIOs to develop and successfully carry out their intended mission, it is critical that there be 'buy in' on the part of the various stakeholder groups that will support and use the RHIOs. Therefore it is very important that not only geographic data be applied to the development of RHIOs, but other considerations such as existing business relationships and other preferences / realities be considered as well. To be successful, RHIOs must be appropriate to the needs of all involved stakeholders.

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APPENDIX A
REFERENCE MAP OF KENTUCKY COUNTIES

Source: Kentucky Office of the Attorney General

APPENDIX B
SPATIAL INTERACTION AMONG SELECTED AREA 5 COUNTIES
MEDICAID CLAIMS

$$\frac{\text{Claims 1 X Claims 2}}{\text{Distance}^2}$$

The gravity model is a measure of spatial interaction used, in this case, to measure the degree to which patients are traveling between two counties. The numerator is computed by multiplying the number of claims from patients living in County 1 who received services in County 2 by the number of patients living in County 2 who received services in County 1. This figure is then divided by the squared distance between the two counties.

Examples are shown for five northern Kentucky counties, using Medicaid claims data. The statistics in the first example show that 3949 claims in Campbell County were from Boone County patients; 2059 claims in Boone County were from Campbell County patients. The distance between the two county centroids (geographic centers) is 19 miles. The overall gravity statistic is 22524, indicating a high level of travel or, spatial interaction, between these two counties for Medicaid services. The gravity statistic is relative, not absolute (imagine the large statistic that would result from interaction between New York and Philadelphia).

Boone/Campbell

$3949 * 2059 / 19^2 = 22524$

Boone/Kenton

$4474 * 5235 / 11^2 = 193565$

Kenton/Campbell

$6228 * 7238 / 9^2 = 556522$

Carroll/Jefferson **vs.** **Carroll/Kenton**

$188 * 88 / 45^2 = 8$ vs. $116 * 4 / 37^2 = 0.3$

Note: For Medicaid claims data, there is more spatial interaction between Carroll and Jefferson Counties than Carroll and Kenton Counties, despite greater distance.

Owen/Fayette **vs.** **Owen/Franklin** **vs.** **Owen/Kenton**

$432 * 49 / 39^2 = 14$ vs. $427 * 67 / 27^2 = 39$ vs. $411 * 292 / 33^2 = 110$

Note: this supports the inclusion of Owen County in Kenton County's MTA.

Mason/Fayette **vs.** **Mason/Fleming** **vs.** **Mason/Marion**

$1167 * 182 / 52^2 = 79$ vs. $1139 * 975 / 17^2 = 3843$ vs. $1107 * 1 / 107^2 = 0.1$

Note: There was no reverse flow between Marion & Mason. A placeholder of 1 was used to prevent a zero numerator.